



#6

Sequence List

<110> Betenbaugh et al.

<120> Engineering Intracellular Sialylation Pathways

<130> PF509P2

<140> 09/930,440

<141> 2001-08-16

<150> 60/227,579

<151> 2000-08-25

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<151> 2000-03-01

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<151> 1999-12-08

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<170> PatentIn Ver. 2.1

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1	5	10	15													

acg	cca	atg	act	gag	aat	gga	gaa	atc	aac	ttt	tca	gta	att	ggt	cag	96
Thr	Pro	Met	Thr	Glu	Asn	Gly	Glu	Ile	Asn	Phe	Ser	Val	Ile	Gly	Gln	
20	25	30														

tat	gtg	gat	tat	ctt	gtg	aaa	gaa	cag	gga	gtg	aag	aac	att	ttt	gtg	144
Tyr	Val	Asp	Tyr	Leu	Val	Lys	Glu	Gln	Gly	Val	Lys	Asn	Ile	Phe	Val	
35	40	45														

aat	ggc	aca	aca	gga	gaa	ggc	ctg	tcc	ctg	agc	gtc	tca	gag	cgt	cgc	192
Asn	Gly	Thr	Thr	Gly	Gly	Gly	Leu	Ser	Leu	Ser	Val	Ser	Glu	Arg	Arg	
50	55	60														

cag	gtt	gca	gag	gag	tgg	gtg	aca	aaa	ggg	aag	gac	aag	ctg	gat	cag	240
Gln	Val	Ala	Glu	Glu	Trp	Val	Thr	Lys	Gly	Lys	Asp	Lys	Leu	Asp	Gln	
65	70	75	80													

gtg	ata	att	cac	gta	gga	gca	ctg	agc	ttg	aag	gag	tca	cag	gaa	ctg	288
Val	Ile	Ile	His	Val	Gly	Ala	Leu	Ser	Leu	Lys	Glu	Ser	Gln	Glu	Leu	
85	90	95														

gcc caa cat gca gca gaa ata gga gct gat ggc atc gct gtc att gca Ala Gln His Ala Ala Glu Ile Gly Ala Asp Gly Ile Ala Val Ile Ala	336
100 105 110	
ccg ttc ttc ctc aag cca tgg acc aaa gat atc ctg att aat ttc cta Pro Phe Phe Leu Lys Pro Trp Thr Lys Asp Ile Leu Ile Asn Phe Leu	384
115 120 125	
aag gaa gtg gct gct gcc gcc cct gcc ctg cca ttt tat tac tat cac Lys Glu Val Ala Ala Ala Pro Ala Leu Pro Phe Tyr Tyr Tyr His	432
130 135 140	
att cct gcc ttg aca ggg gta aag att cgt gct gag gag ttg ttg gat Ile Pro Ala Leu Thr Gly Val Lys Ile Arg Ala Glu Glu Leu Leu Asp	480
145 150 155 160	
ggg att ctg gat aag atc ccc acc ttc caa ggg ctg aaa ttc agt gat Gly Ile Leu Asp Lys Ile Pro Thr Phe Gln Gly Leu Lys Phe Ser Asp	528
165 170 175	
aca gat ctc tta gac ttc ggg caa tgt gtt gat cag aat cgc cag caa Thr Asp Leu Leu Asp Phe Gly Gln Cys Val Asp Gln Asn Arg Gln Gln	576
180 185 190	
cag ttt gct ttc ctt ttt ggg gtg gat gag caa ctg ttg agt gct ctg Gln Phe Ala Phe Leu Phe Gly Val Asp Glu Gln Leu Leu Ser Ala Leu	624
195 200 205	
gtg atg gga gca act gga gca gtg ggc agt ttt gta tcc aga gat tta Val Met Gly Ala Thr Gly Ala Val Gly Ser Phe Val Ser Arg Asp Leu	672
210 215 220	
tca act ttg ttg tca aac tag gttttggagt gtcacagacc aaagccatca Ser Thr Leu Leu Ser Asn	723
225 230	
tgactctggc ccaatggcc cacccggct tccactgcag aaagcctcca 783	
gggagttac tgatagtgct gaagctaac tgaagagcct ggatttcctt tctttcactg 843	
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 35 40 45
 Asn Gly Thr Thr Gly Glu Gly Leu Ser Leu Ser Val Ser Glu Arg Arg
 50 55 60
 Gln Val Ala Glu Glu Trp Val Thr Lys Gly Lys Asp Lys Leu Asp Gln
 65 70 75 80
 Val Ile Ile His Val Gly Ala Leu Ser Leu Lys Glu Ser Gln Glu Leu
 85 90 95
 Ala Gln His Ala Ala Glu Ile Gly Ala Asp Gly Ile Ala Val Ile Ala
 100 105 110
 Pro Phe Phe Leu Lys Pro Trp Thr Lys Asp Ile Leu Ile Asn Phe Leu
 115 120 125
 Lys Glu Val Ala Ala Ala Ala Pro Ala Leu Pro Phe Tyr Tyr Tyr His
 130 135 140
 Ile Pro Ala Leu Thr Gly Val Lys Ile Arg Ala Glu Glu Leu Leu Asp
 145 150 155 160
 Gly Ile Leu Asp Lys Ile Pro Thr Phe Gln Gly Leu Lys Phe Ser Asp
 165 170 175
 Thr Asp Leu Leu Asp Phe Gly Gln Cys Val Asp Gln Asn Arg Gln Gln
 180 185 190
 Gln Phe Ala Phe Leu Phe Gly Val Asp Glu Gln Leu Leu Ser Ala Leu
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 Ser Thr Leu Leu Ser Asn
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1				5					10				15			

ggg	cga	ccg	tcc	cgg	ggc	ccg	ccg	aag	ctg	cag	cgc	aac	tct	cgc	96	
Gly	Arg	Pro	Ser	Arg	Gly	Arg	Pro	Pro	Lys	Leu	Gln	Arg	Asn	Ser	Arg	
20				25							30					

ggc	ggc	cag	ggc	cga	ggt	gtg	gag	aag	ccc	ccg	cac	ctg	gca	gcc	cta	144
Gly	Gly	Gln	Gly	Arg	Gly	Val	Glu	Lys	Pro	Pro	His	Leu	Ala	Ala	Leu	
35				40					45							

att	ctg	gcc	cgg	gga	ggc	agc	aaa	ggc	atc	ccc	ctg	aag	aac	att	aag	192
Ile	Leu	Ala	Arg	Gly	Gly	Ser	Lys	Gly	Ile	Pro	Leu	Lys	Asn	Ile	Lys	
50				55					60							

cac	ctg	gcf	ggg	gtc	ccg	ctc	att	ggc	tgg	gtc	ctg	cgt	gcf	gcc	ctg	240
His	Leu	Ala	Gly	Val	Pro	Leu	Ile	Gly	Trp	Val	Leu	Arg	Ala	Ala	Leu	
65				70					75			80				

gat	tca	ggg	gcc	ttc	cag	agt	gta	tgg	gtt	tcg	aca	gac	cat	gat	gaa	288
Asp	Ser	Gly	Ala	Phe	Gln	Ser	Val	Trp	Val	Ser	Thr	Asp	His	Asp	Glu	
85				90						95						

att	gag	aat	gtg	gcc	aaa	caa	ttt	gg	gt	gca	caa	gtt	cat	cga	aga	agt	336
Ile	Glu	Asn	Val	Ala	Lys	Gln	Phe	Gly	Ala	Gln	Val	His	Arg	Arg	Ser		
100				105					110								

tct	gaa	gtt	tca	aaa	gac	agc	tct	acc	tca	cta	gat	gcc	atc	ata	gaa	384
Ser	Glu	Val	Ser	Lys	Asp	Ser	Ser	Thr	Ser	Leu	Asp	Ala	Ile	Ile	Glu	
115				120					125							

ttt	ctt	aat	tat	yat	aat	gag	gkt	gac	att	gta	gga	aat	att	caa	gct	432
Phe	Leu	Asn	Tyr	Xaa	Asn	Glu	Xaa	Asp	Ile	Val	Gly	Asn	Ile	Gln	Ala	
130				135					140							

act	tct	yca	tgt	tta	cat	cct	act	gat	ctt	caa	aaa	gtt	gca	gaa	atg	480
Thr	Ser	Xaa	Cys	Leu	His	Pro	Thr	Asp	Leu	Gln	Lys	Val	Ala	Glu	Met	
145				150					155			160				

att	cga	gaa	gga	tat	gat	tct	gkt	ttc	tct	gtt	gtg	aga	cgc	cat	528
Ile	Arg	Glu	Gly	Tyr	Asp	Ser	Xaa	Phe	Ser	Val	Val	Arg	Arg	His	
165				170					175						

cag	ttt	cga	tgg	agt	gaa	att	cag	aaa	gga	gtt	cgt	gaa	gtg	acc	gaa	576
Gln	Phe	Arg	Trp	Ser	Glu	Ile	Gln	Lys	Gly	Val	Arg	Glu	Val	Thr	Glu	
180				185					190							

cct	ctg	aat	tta	aat	cca	gct	aaa	cgg	cct	cgt	cga	caa	gac	tgg	gat	624
Pro	Leu	Asn	Leu	Asn	Pro	Ala	Lys	Arg	Pro	Arg	Arg	Gln	Asp	Trp	Asp	
195				200					205							

gga	gaa	tta	tat	gaa	aat	ggc	tca	ttt	tat	ttt	gct	aaa	aga	cat	ttg	672

Gly	Glu	Leu	Tyr	Glu	Asn	Gly	Ser	Phe	Tyr	Phe	Ala	Lys	Arg	His	Leu	
210						215					220					
ata	gag	atg	ggt	tac	ttg	cag	ggt	gga	aaa	tgg	cat	act	acg	aaa	tgc	720
Ile	Glu	Met	Gly	Tyr	Leu	Gln	Gly	Gly	Lys	Trp	His	Thr	Thr	Lys	Cys	
225					230				235					240		
gag	ctg	gaa	cat	agt	gtg	gat	ata	gat	gtg	gat	att	gat	tgg	cct	att	768
Glu	Leu	Glu	His	Ser	Val	Asp	Ile	Asp	Val	Asp	Ile	Asp	Trp	Pro	Ile	
245					250				255							
gca	gag	caa	aga	gta	tta	aga	tat	ggc	tat	ttt	ggc	aaa	gag	aag	ctt	816
Ala	Glu	Gln	Arg	Val	Leu	Arg	Tyr	Gly	Tyr	Phe	Gly	Lys	Glu	Lys	Leu	
260					265						270					
aag	gaa	ata	aaa	ctt	ttg	gtt	tgc	aat	att	gat	gga	tgt	ctc	acc	aat	864
Lys	Glu	Ile	Lys	Leu	Leu	Val	Cys	Asn	Ile	Asp	Gly	Cys	Leu	Thr	Asn	
275					280				285							
ggc	cac	att	tat	gta	tca	gga	gac	caa	aaa	gaa	ata	ata	tct	tat	gat	912
Gly	His	Ile	Tyr	Val	Ser	Gly	Asp	Gln	Lys	Glu	Ile	Ile	Ser	Tyr	Asp	
290				295					300							
gta	aaa	gat	gct	att	ggg	ata	agt	tta	tta	aag	aaa	agt	ggt	att	gag	960
Val	Lys	Asp	Ala	Ile	Gly	Ile	Ser	Leu	Leu	Lys	Lys	Ser	Gly	Ile	Glu	
305					310					315				320		
gtg	agg	cta	atc	tca	gaa	agg	gcc	tgt	tca	aag	cag	acg	ctg	tct	tct	1008
Val	Arg	Leu	Ile	Ser	Glu	Arg	Ala	Cys	Ser	Lys	Gln	Thr	Leu	Ser	Ser	
325					330					335						
tta	aaa	ctg	gat	tgc	aaa	atg	gaa	gtc	agt	gta	tca	gac	aag	cta	gca	1056
Leu	Lys	Leu	Asp	Cys	Lys	Met	Glu	Val	Ser	Val	Ser	Asp	Lys	Leu	Ala	
340					345					350						
gtt	gta	gat	gaa	tgg	aga	aaa	gaa	atg	ggc	ctg	tgc	tgg	aaa	gaa	gtg	1104
Val	Val	Asp	Glu	Trp	Arg	Lys	Glu	Met	Gly	Leu	Cys	Trp	Lys	Glu	Val	
355					360					365						
gca	tat	ctt	gga	aat	gaa	gtg	tct	gat	gaa	gag	tgc	ttg	aag	aga	gtg	1152
Ala	Tyr	Leu	Gly	Asn	Glu	Val	Ser	Asp	Glu	Glu	Cys	Leu	Lys	Arg	Val	
370					375					380						
ggc	cta	agt	ggc	gct	cct	gct	gat	gcc	tgt	tcc	tac	gcc	cag	aag	gct	1200
Gly	Leu	Ser	Gly	Ala	Pro	Ala	Asp	Ala	Cys	Ser	Tyr	Ala	Gln	Lys	Ala	
385					390					395			400			
gtt	gga	tac	att	tgc	aaa	tgt	aat	ggt	ggc	cgt	ggt	gcc	atc	cga	gaa	1248
Val	Gly	Tyr	Ile	Cys	Lys	Cys	Asn	Gly	Gly	Arg	Gly	Ala	Ile	Arg	Glu	
405								410					415			
ttt	gca	gag	cac	att	tgc	cta	cta	atg	gaa	aaa	gtt	aat	aat	tca	tgc	1296
Phe	Ala	Glu	His	Ile	Cys	Leu	Leu	Met	Glu	Lys	Val	Asn	Asn	Ser	Cys	
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caa	aaa	tag													1305	
Gln	Lys															

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	20					25								30	
Gly	Gly	Gln	Gly	Arg	Gly	Val	Glu	Lys	Pro	Pro	His	Leu	Ala	Ala	Leu
	35					40					45				
Ile	Leu	Ala	Arg	Gly	Gly	Ser	Lys	Gly	Ile	Pro	Leu	Lys	Asn	Ile	Lys
	50					55					60				
His	Leu	Ala	Gly	Val	Pro	Leu	Ile	Gly	Trp	Val	Leu	Arg	Ala	Ala	Leu
	65					70				75				80	
Asp	Ser	Gly	Ala	Phe	Gln	Ser	Val	Trp	Val	Ser	Thr	Asp	His	Asp	Glu
					85				90				95		
Ile	Glu	Asn	Val	Ala	Lys	Gln	Phe	Gly	Ala	Gln	Val	His	Arg	Arg	Ser
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Ser	Glu	Val	Ser	Lys	Asp	Ser	Ser	Thr	Ser	Leu	Asp	Ala	Ile	Ile	Glu
					115			120				125			
Phe	Leu	Asn	Tyr	Xaa	Asn	Glu	Xaa	Asp	Ile	Val	Gly	Asn	Ile	Gln	Ala
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Thr	Ser	Xaa	Cys	Leu	His	Pro	Thr	Asp	Leu	Gln	Lys	Val	Ala	Glu	Met
						145		150			155			160	
Ile	Arg	Glu	Glu	Gly	Tyr	Asp	Ser	Xaa	Phe	Ser	Val	Val	Arg	Arg	His
						165			170				175		
Gln	Phe	Arg	Trp	Ser	Glu	Ile	Gln	Lys	Gly	Val	Arg	Glu	Val	Thr	Glu
						180			185			190			
Pro	Leu	Asn	Leu	Asn	Pro	Ala	Lys	Arg	Pro	Arg	Arg	Gln	Asp	Trp	Asp
						195		200			205				
Gly	Glu	Leu	Tyr	Glu	Asn	Gly	Ser	Phe	Tyr	Phe	Ala	Lys	Arg	His	Leu
						210		215			220				
Ile	Glu	Met	Gly	Tyr	Leu	Gln	Gly	Lys	Trp	His	Thr	Thr	Lys	Cys	
						225		230			235			240	
Glu	Leu	Glu	His	Ser	Val	Asp	Ile	Asp	Val	Asp	Ile	Asp	Trp	Pro	Ile
						245			250				255		
Ala	Glu	Gln	Arg	Val	Leu	Arg	Tyr	Gly	Tyr	Phe	Gly	Lys	Glu	Lys	Leu
						260			265			270			
Lys	Glu	Ile	Lys	Leu	Leu	Val	Cys	Asn	Ile	Asp	Gly	Cys	Leu	Thr	Asn

275	280	285
Gly His Ile Tyr Val Ser Gly Asp Gln Lys Glu Ile Ile Ser Tyr Asp		
290	295	300
Val Lys Asp Ala Ile Gly Ile Ser Leu Leu Lys Lys Ser Gly Ile Glu		
305	310	315
Val Arg Leu Ile Ser Glu Arg Ala Cys Ser Lys Gln Thr Leu Ser Ser		
325	330	335
Leu Lys Leu Asp Cys Lys Met Glu Val Ser Val Ser Asp Lys Leu Ala		
340	345	350
Val Val Asp Glu Trp Arg Lys Glu Met Gly Leu Cys Trp Lys Glu Val		
355	360	365
Ala Tyr Leu Gly Asn Glu Val Ser Asp Glu Glu Cys Leu Lys Arg Val		
370	375	380
Gly Leu Ser Gly Ala Pro Ala Asp Ala Cys Ser Tyr Ala Gln Lys Ala		
385	390	395
Val Gly Tyr Ile Cys Lys Cys Asn Gly Gly Arg Gly Ala Ile Arg Glu		
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Phe Ala Glu His Ile Cys Leu Leu Met Glu Lys Val Asn Asn Ser Cys		
420	425	430
Gln Lys		

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1	5	10
		15
cac ccg tgc ttc atc att gcc gag atc ggc cag aac cac cag ggc gac		96
His Pro Cys Phe Ile Ile Ala Glu Ile Gly Gln Asn His Gln Gly Asp		
20	25	30
ctg gac gta gcc aag cgc atg atc cgc atg gcc aag gag tgt ggg gct		144
Leu Asp Val Ala Lys Arg Met Ile Arg Met Ala Lys Glu Cys Gly Ala		
35	40	45
gat tgt gcc aag ttc cag aag agt gag cta gaa ttc aag ttt aat cgg		192
Asp Cys Ala Lys Phe Gln Lys Ser Glu Leu Glu Phe Lys Phe Asn Arg		
50	55	60
aaa gcc ttg gag agg cca tac acc tcg aag cat tcc tgg ggg aag acg		240
Lys Ala-Leu Glu Arg Pro Tyr Thr Ser Lys His Ser Trp Gly Lys Thr		
65	70	75
		80
tac ggg gag cac aaa cga cat ctg gag ttc agc cat gac cag tac agg		288
Tyr Gly Glu His Lys Arg His Leu Glu Phe Ser His Asp Gln Tyr Arg		
85	90	95
gag ctg cag agg tac gcc gag gag gtt ggg atc ttc ttc act gcc tct		336
Glu Leu Gln Arg Tyr Ala Glu Glu Val Gly Ile Phe Phe Thr Ala Ser		
100	105	110

ggc atg gat gag atg gca gtt gaa ttc ctg cat gaa ctg aat gtt cca Gly Met Asp Glu Met Ala Val Glu Phe Leu His Glu Leu Asn Val Pro 115 120 125	384
ttt ttc aaa gtt gga tct gga gac act aat aat ttt cct tat ctg gaa Phe Phe Lys Val Gly Ser Gly Asp Thr Asn Asn Phe Pro Tyr Leu Glu 130 135 140	432
aag aca gcc aaa aaa ggt cgc cca atg gtg atc tcc agt ggg atg cag Lys Thr Ala Lys Lys Gly Arg Pro Met Val Ile Ser Ser Gly Met Gln 145 150 155 160	480
tca atg gac acc atg aag caa gtt tat cag atc gtg aag ccc ctc aac Ser Met Asp Thr Met Lys Gln Val Tyr Gln Ile Val Lys Pro Leu Asn 165 170 175	528
ccc aac ttc tgc ttc ttg cag tgt acc agc gca tac ccg ctc cag cct Pro Asn Phe Cys Phe Leu Gln Cys Thr Ser Ala Tyr Pro Leu Gln Pro 180 185 190	576
gag gac gtc aac ctg cgg gtc atc tcg gaa tat cag aag ctc ttt cct Glu Asp Val Asn Leu Arg Val Ile Ser Glu Tyr Gln Lys Leu Phe Pro 195 200 205	624
gac att ccc ata ggg tat tct ggg cat gaa aca ggc ata gcg ata tct Asp Ile Pro Ile Gly Tyr Ser Gly His Glu Thr Gly Ile Ala Ile Ser 210 215 220	672
gtg gcc gca gtg gct ctg ggg gcc aag gtg ttg gaa cgt cac ata act Val Ala Ala Val Ala Leu Gly Ala Lys Val Leu Glu Arg His Ile Thr 225 230 235 240	720
ttg gac aag acc tgg aag ggg agt gac cac tcg gcc tcg ctg gag cct Leu Asp Lys Thr Trp Lys Gly Ser Asp His Ser Ala Ser Leu Glu Pro 245 250 255	768
gga gaa ctg gcc gag ctg gtg cgg tca gtg cgt ctt gtg gag cgt gcc Gly Glu Leu Ala Glu Leu Val Arg Ser Val Arg Leu Val Glu Arg Ala 260 265 270	816
ctg ggc tcc cca acc aag cag ctg ctg ccc tgt gag atg gcc tgc aat Leu Gly Ser Pro Thr Lys Gln Leu Leu Pro Cys Glu Met Ala Cys Asn 275 280 285	864
gag aag ctg ggc aag tct gtg gtg gcc aaa gtg aaa att ccg gaa ggc Glu Lys Leu Gly Lys Ser Val Val Ala Lys Val Lys Ile Pro Glu Gly 290 295 300	912
acc att cta aca atg gac atg ctc acc gtg aag gtg ggt gag ccc aaa Thr Ile Leu Thr Met Asp Met Leu Thr Val Lys Val Gly Glu Pro Lys 305 310 315 320	960
gcc tat cct cct gaa gac atc ttt aat cta gtg ggc aag aag gtc ctg Ala Tyr Pro Pro Glu Asp Ile Phe Asn Leu Val Gly Lys Lys Val Leu 325 330 335	1008
gtc act gtt gaa gag gat gac acc atc atg gaa gaa ttg gta gat aat Val Thr Val Glu Glu Asp Asp Thr Ile Met Glu Glu Leu Val Asp Asn 340 345 350	1056
cat ggc aaa aaa atc aag tct taa	1080

His Gly Lys Lys Ile Lys Ser
355

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20 25 30
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35 40 45
Asp Cys Ala Lys Phe Gln Lys Ser Glu Leu Glu Phe Lys Phe Asn Arg
50 55 60
Lys Ala Leu Glu Arg Pro Tyr Thr Ser Lys His Ser Trp Gly Lys Thr
65 70 75 80
Tyr Gly Glu His Lys Arg His Leu Glu Phe Ser His Asp Gln Tyr Arg
85 90 95
Glu Leu Gln Arg Tyr Ala Glu Glu Val Gly Ile Phe Phe Thr Ala Ser
100 105 110
Gly Met Asp Glu Met Ala Val Glu Phe Leu His Glu Leu Asn Val Pro
115 120 125
Phe Phe Lys Val Gly Ser Gly Asp Thr Asn Asn Phe Pro Tyr Leu Glu
130 135 140
Lys Thr Ala Lys Lys Gly Arg Pro Met Val Ile Ser Ser Gly Met Gln
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